WHAT IS CLAIMED IS:

1. An ion beam apparatus comprising:

a scanner which scans an injected ion beam around a given scan center within a given scan surface; and

an electrostatic deflector which electrostatically deflects the ion beam ejected from the scanner through 90° so that an ion beam of desired energy travels in a direction perpendicular to the scan surface within a circular-arc-shaped deflection zone centered on the scan center.

2. The ion beam apparatus comprising:

an ion source which extracts an ion beam;

a mass separation electromagnet which separates an ion beam of desired mass from the ion beam extracted from the ion source;

a scanner which scans the ion beam that has been passed through the mass separation electromagnet around a given scan center within a given scan surface;

an electrostatic deflector which electrostatically deflects the ion beam ejected from the scanner through 90° so that an ion beam of desired energy travels in a direction perpendicular to the scan surface within a circular-arc-shaped deflection zone centered on the scan center; and

a scanning mechanism which retains a target for ion implantation and which mechanically, reciprocally moves the target in a direction in which the target crosses the ion beam ejected from the electrostatic

deflector at a given angle.

3. The ion beam apparatus according to claim 2, wherein said scanning mechanism moves said target in a direction parallel to a surface of said target.

4. The ion beam apparatus according to any one of claims 1 to 3, wherein said electrostatic deflector has a pair of deflection electrodes which are spaced apart from each other and mutually oppose.

5. The ion beam apparatus according to claim 4, wherein, provided that three axes intersecting at right angles at one point are taken as X, Y and Z axes,

said ion beam is injected into said scanner in parallel to said Z axis;

said scanner which scans said injected ion beam with said scan center as a center within said scan surface parallel to a Y-Z plane; and

said electrostatic deflector which deflects an ion beam of desired energy in said injected ion beam through 90° so as to eject in parallel with said X axis;

when consideration is given of a locus of one ion beam having desired energy in said scanned and deflected ion beam, said locus assumes the shape of an arc-shaped section at an extremity of a linear section, said arc-shaped section being bent in the manner of an arc

at an angle of 90° so as to become parallel to said X axis; and

mutually-opposing surfaces of a pair of deflection electrodes constituting said electrostatic deflector each have a shape generally aligned with a surface of revolution, said surface of revolution being drawn by said arc-shaped section when said locus of one ion beam is rotated through a predetermined angle in said scanning direction with reference to an axis passing through said scan center and parallel to said X axis.

6. The ion beam apparatus according to claim 5, wherein said mutually-opposing surfaces of said respective deflection electrodes constituting said deflection electrode each assume a shape defined by means of circumferentially cutting a torus through a predetermined angle centered on a torus center axis which passes through the scan center and is parallel to the X axis, and cutting an outer periphery of a longitudinal cross-sectional surface of said torus through only 90°.

7. The ion beam apparatus according to claim 5 or claim 6, wherein said mutually-opposing surfaces of said pair of deflection electrodes constituting said deflection electrodes are each formed by combination of a plurality of surfaces aligned with said surface of revolution.

8. The ion beam apparatus according to any one of claims

4 to 7, wherein at least one of said pair of deflection electrodes constituting said electrostatic deflector is divided into a plurality of segments with a gap in a direction in which a deflection angle is increased.

9. The ion beam apparatus according to any one of claims 4 to 8, wherein at least said mutually-opposing surfaces of said pair of deflection electrodes constituting said electrostatic deflector are formed from carbon.

10. The ion beam apparatus according to any one of claims 4 to 9, further comprising:

a deflection power source for applying a deflection voltage, which is a d.c. voltage and symmetrical with respect to a ground voltage, to said mutually-opposing surfaces of said pair of deflection electrodes constituting said electrostatic deflector.

11. The ion beam apparatus according to any one of claims 1 to 10, wherein said scanner scans said ion beam that has injected into said scanner in a symmetrical manner with respect to an incident axis of said ion beam.

12. The ion beam apparatus according to any one of claims 1 to 10, wherein said scanner scans said ion beam that has injected into said scanner in only an area on one side with respect to an

incident axis of said ion beam.

13. The ion beam apparatus according to any one of claims 1 to 12, further comprising:

an acceleration/deceleration device which is interposed between said scanner and said electrostatic deflector and electrostatically accelerates or decelerates said scanned ion beam,

wherein said acceleration/deceleration device has at least two electrodes spaced a given interval in a traveling direction of said ion beam; and

each of said electrodes has a circular-arc shape centered on said scan center, and a beam passage hole which is wider than said scanned ion beam in said scanning direction.

14. The ion beam apparatus according to claim 13, wherein an entrance electrode constituting said acceleration/deceleration device also serves as an analysis slit which permits passage of an ion beam of desired mass and inhibits passage of ions of undesired mass.

15. The ion beam apparatus according to any one of claims 1 to 14, wherein a beam mask which permits passage of an ion beam of desired energy and inhibits passage of ions of undesired energy is disposed in the vicinity of an exit of said electrostatic deflector.

16. The ion beam apparatus according to claim 15, wherein a scanned beam cross section of said ion beam passed from said electrostatic deflector, the scanned beam cross section perpendicular to a traveling direction of said ion beam, assumes the shape of an arc, and said beam mask has a beam passage hole having an arc-shaped geometry substantially similar to said arc-shaped scanned beam cross section.

17. The ion beam apparatus according to any one of claims 1 to 16, wherein said scanner has a pair of mutually-parallel scan electrodes, and a scan power source which applies a scan voltage Vs expressed by $V_s = ct/(1-c^2t^2)^{1/2}$ ("c" is a constant, and "t" is time) between said pair of scan electrodes.

18. The ion beam apparatus according to any one of claims 1 to 3, wherein an entrance potential of said electrostatic deflector is lower than an exit potential of the same; and

said electrostatic deflector decelerates said ion beam of desired energy among said ion beam that has injected into said electrostatic deflector while deflecting said ion beam in the manner mentioned previously.

19. The ion beam apparatus according to any one of claims 1 to 3, wherein an entrance potential of said electrostatic deflector is higher than an exit potential of the same; and

said electrostatic deflector accelerates said ion beam of desired energy among said ion beams that has injected into said electrostatic deflector while deflecting said ion beam in the manner mentioned previously.

20. The ion beam apparatus according claim 18, wherein said electrostatic deflector has inner and outer deflection electrodes which oppose each other with an interval therebetween; and

said interval between said mutually-opposing surfaces of said inner and outer deflection electrodes becomes wider toward said exit of said deflector.

21. The ion beam apparatus according to claim 19, wherein said electrostatic deflector has inner and outer deflection electrodes which oppose each other with an interval therebetween; and

said interval between said mutually-opposing surfaces of said inner and outer deflection electrodes becomes narrower toward said exit of said deflector.

22. The ion beam apparatus according claim 18, wherein the following relationships are satisfied on condition that said electrostatic deflector has inner and outer deflection electrodes which oppose each other with an interval therebetween; that said inner and outer deflection electrodes are divided into "n" pairs

("n" is an integer of two or more) in a direction in which said deflection angles increase, to thus form "n" deflection electrode pairs; that voltages applied to said inner deflection electrodes among said "n" deflection electrode pairs are taken as Va_1, Va_2, ..., Va_n in sequence from said entrance; and that voltages applied to said outer deflection electrodes among said "n" deflection electrode pairs are taken as Vb_1, Vb_2, ..., Vb_n in sequence from said entrance,

$Va_1 < Va_2 < \ldots < Va_n$,

$Vb_1 < Vb_2 < \ldots < Vb_n$, and

$Va_1 < Vb_1$, $Va_2 < Vb_2$, ..., $Va_n < Vb_n$.

23. The ion beam apparatus according claim 19, wherein the following relationships are satisfied on condition that said electrostatic deflector has inner and outer deflection electrodes which oppose each other with an interval therebetween; that said inner and outer deflection electrodes are divided into "n" pairs ("n" is an integer of two or more) in a direction in which said deflection angles increase, to thus form "n" deflection electrode pairs; that voltages applied to said inner deflection electrodes among said "n" deflection electrode pairs are taken as Va_1, Va_2, ..., Va_n in sequence from said entrance; and that voltages applied to said outer deflection electrodes among said "n" deflection electrode pairs are taken as Vb_1, Vb_2, ..., Vb_n in sequence from said entrance,

$Va_1 > Va_2 > \ldots > Va_n$,

$Vb_1 > Vb_2 > \ldots > Vb_n$, and

$Va_1 < Vb_1$, $Va_2 < Vb_2$, …, $Va_n < Vb_n$.

24. The ion beam apparatus according claim 22 or claim 23, wherein said interval between said mutually-opposing surfaces of said respective "n" deflection electrode pairs is constant from said entrance to said exit of said electrostatic deflector.

25. The ion beam apparatus according claim 22, wherein said interval between said mutually-opposing surfaces in said respective "n" deflection electrode pairs becomes wider toward said exit of said deflector.

26. The ion beam apparatus according claim 23, wherein said interval between said mutually-opposing surfaces in said respective "n" deflection electrode pairs becomes narrower toward said exit of said deflector.

27. The ion beam apparatus according claim 18 or claim 19, wherein the following expressions or equivalent mathematical relationships are substantially satisfied on condition that said electrostatic deflector has inner and outer deflection electrodes which oppose each other with an interval therebetween; that radii of mutually-opposing surfaces of said inner and outer deflection electrodes are taken as ra and rb; that voltages applied to said inner and outer deflection electrodes are taken as Va and Vb; an

electric potential in an orbit of said ion beam of desired energy within said electrostatic deflector is taken as V; a voltage corresponding to said ion beam of kinetic energy at said exit of said electrostatic deflector is taken as Ve; and a design orbit radius of said ion beam within said electrostatic deflector is taken as rc;

$$Va = V - 2(Ve - V) \log(rc/ra), \text{ and}$$

$$Vb = V + 2(Ve - V) \log(rb/rc).$$